A Nursery Guide for Propagating Poplars

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by Michael J. Morin
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Introduction

The purpose of this guide is to present basic techniques for the nursery propagation of poplars, with emphasis on hybrids. It is written primarily for the practicing nurseryman and assumes some knowledge of basic nursery operations. Many of the methods described are standard operational procedures. The ones dealing specifically with the culture of poplars are by no means the only feasible ones. They have, however, been derived from actual practice and have proven to be both efficient and economical in their application.

The guide has three basic sections. In the first section, we describe poplars and give suggestions on their selection. The second section outlines a technique for propagating cuttings, while the third explains a procedure for growing rooted cuttings.

Poplars

Poplars encompass a large group of woody plants that have worldwide forestry significance. Because of their fast growth, they are often sought for reforestation, reclamation, windbreaks, and as quick sources of fuelwood. They belong to what is taxonomically named the genus *Populus* L. This genus is comprised of five divisions called sections. They are *Leuce* Duby, *Aegeirus* S.F. Gray, *Tacamahaca* Spach, *Leucoides* Spach, and *Turanga* Bge.. The section *Leuce* includes both bigtooth and trembling aspen, sometimes referred to as popples. These reproduce mainly from root sprouts or seeding and are not the subject of, or included in, the term poplar and hybrid poplar as used in this guide.

The poplars described in this manual refer mainly to *P. deltoides* Marsh. (eastern cottonwood) and hybrid poplars that come from

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Hybrid poplars used for street-tree planting —age 13.

within or between crosses of the section *Aegeirus* and *Tacamahaca*. The hybrid poplars originated from breeding programs undertaken by Dr. Ernst J. Schreiner in the 1920's and from crossing programs in Canada and Europe. From these programs, superior individuals were selected for cloning. A clone is defined as a group of plants that have been reproduced by vegetative means thereby preserving their genetic identity. These clones were then given common names and/or numbers. They have been widely used throughout the world.

Selecting Clones to Propagate

Carefully select clones to be propagated in a nursery. Not all available clones are superior. Some are extremely susceptible to diseases or will grow poorly in certain regions of the country. Seek the advice of knowledgeable people from the region in which the poplars will be utilized. Appendix I gives a partial list of experts from various regions.

Stool Beds

Site Selection

A "Stool" is a stump from which the sprouts are harvested yearly and utilized for producing cuttings. The soil requirements for growing a poplar stool bed are broad. Good soil drainage is desirable, since it allows proper aeration for the roots and the soil remains accessible to equipment during the wet seasons. A texture of sand to sandy loam or even loam is preferred, and heavy, compacted clays with poor drainage should be avoided. Since fertilizers can easily be applied, nutrient content is not a limiting factor. Access to a good water supply is important, since poplars require large amounts of moisture to maximize growth. Land that can be easily irrigated is a definite advantage. However, in nutrient-rich soils, irrigation may not be necessary if there is a flowing water table within 2.5 to 5 feet of the surface. Soil pH must be 5.0 or more. The ideal level is 6.0 to 6.8. Avoid choosing a site that is subject to late spring or early fall frosts. Good air drainage is also desirable.

Site Preparation

Once the site has been selected, it is important to prepare the soil well prior to planting. If the area supports any perennial weeds such as quackgrass, be certain to eliminate them. Soil fumigation is very effective but an unnecessary expense. Roundup®, applied according to manufacturer's recommendations, gives good control of many noxious weeds. Next, work the soil deeply with implements such as plows, disks, soil savers, or rototillers.

At this time, make any pH or nutrient adjustments in phosphorus (P) and potasium (K). Levels of these elements should be between 200 and 350 pounds per acre.

Design and Planting

The actual shape and design of the stool bed will vary with location. It is important to plan roadways (in stool beds of 2 or more acres) for easy access at harvest time or for pesticide treatment. Often, stools sprout 10 feet or more in one year, hindering access to individual rows or stools. If more than one clone is planted, locate each clone in

pure row blocks. This will facilitate harvesting and allow each clone to be kept separate, before and after harvest. Since insects and diseases may affect clones differently, it is important not to plant clones in mixtures. If mixed outplantings are desired, mix the clones as they are processed or planted.

In selecting the stool bed spacing, the most important factor to consider is the type of tillage equipment that will be available to cultivate the soil between the rows of stools. Choose proper spacing to allow passage of the equipment. Cultivate in the spring before the stools have sprouted. Since nursery land is usually at a premium and irrigation is costly, spacings as close as 1 foot between stools and 3 feet between rows are common. This allows a maximum of 14,500 plants per acre. Although individual stools are easily accessible with wider spacings, this advantage must be balanced with the availability of nursery property. Aim for spacing which accommodates between 3,000 and 15,000 stools per acre.

Correct planting, whether by hand or machine, is important. Unrooted cuttings 8 to 10 inches long and at least 3/8-inch in caliper provide the best results. Small diameter cuttings may be used but the survival rate is usually lower. Roofed cuttings may also be used. Plant cuttings so that no more than 1 inch is above the ground level with at least one good bud showing. Plant rooted cuttings at least 10 to 12 inches deep; then cut their tops to within 2 inches of the ground. If this is not done, the first year's growth will be a stem with multiple large branches that make the first year harvesting and processing very labor-intensive. Use only quality stock of known parentage and performance to establish stool beds. Take extra precautions to ensure that clones do not get mixed or mislabelled in the stool bed. This can happen easily, so close supervision is mandatory.

Maintenance

Once a stool bed has been planted, maintenance is fairly simple. Weed control is important and can be accomplished by either mechanical cultivation, hand weeding, herbicide application, or any combination of these. The choice will depend on the personnel, equipment available, and the weeds present. Remember that because of their rapid growth, poplar stool beds planted at a close spac-

ing will not remain accessible to mechanical treatment more than 3 to 5 weeks at the beginning of the growing season. As the sprouts get taller, the rows will start to close in. This is especially true with close-spaced plantings. Depending on the type of weeds present, chemical and mechanical weed control is usually best. A list of chemicals that have been used successfully with poplars, especially hybrids, is given in Appendix II. Good weed control the first two years of establishment will greatly facilitate weed control in future years.

To maximize growth, adequate nutrient availability is necessary. Except for nitrogen (N) requirements, nutrient deficiencies should be initially corrected at the time the site is prepared. In subsequent years, take soil tests and make nutrient additions in the spring prior to cultivating the stool bed. Apply nitrogen in a minimum of three applications starting as soon as leaves appear and ending in July. Ground application or foliar feeding with the irrigation system will give good results. Apply amounts of 100 to 175 pounds per acre of available N each season.

Poplars also respond well to irrigation. In order to maximize growth, irrigation is usually necessary. Use an overhead or underground trickle system. Water availability and personal preference usually determine which system, either of which will produce satisfactory results, is selected. If an underground system is selected, place it deep enough so that it will not be disturbed when the stool bed is cultivated. Because of cultivation and harvesting requirements, aboveground trickle irrigation is not recommended. Apply at least 1 inch of water weekly during the growing season. Irrigation should supplement rainfall. If a more scientific system is desired, use a tensiometer and apply water whenever a reading of -0.3 to -0.7 bars is recorded.

Although resistant clones are used, the close spacing of stool beds can often lead to high humidity and conditions favorable for the occurrence of diseases, especially *Septoria* cankers. Taking certain precautions can reduce the incidence of these cankers. One is to incorporate leaf litter into the soil (rototilling is best) between the rows of stools in the early spring. The other is to spray a fungicide such as benomyl when the buds start to flush and again in mid-June. Research has not proven that a fungicide will actually prevent *Septoria*

cankers from occurring, but early results are promising (personal experience of senior author). Certainly, eliminating the leaf litter on which the disease spores overwinter will help greatly.

Insects may or may not be a problem. Much depends on location and surrounding vegetation. Make frequent checks to determine their presence. If leaf or stem damage is noticed, it is best to collect samples and have them identified by entomologists, who can suggest methods of control. Preventative spraying with insecticides is not recommended, since it will often harm beneficial insects as well as undesirable ones.

Harvesting and Processing Cuttings

Do not undertake harvesting of stool beds until the stems have become dormant and the wood has hardened off. This usually occurs between December and March. Ideally, the sprouts should be cut

Harvesting stool bed with brushsaw.

and processed soon after harvesting, but it is possible to store the whips prior to making cuttings. Stools can be harvested each year until the quantity and quality of cuttings is reduced or until signs of disease are evident. Stools may remain productive for a maximum of 10 years; however, a 5- to 7-year stool-bed cycle is recommended.

Cut the sprouts 2 to 6 inches above ground level. A variety of equipment, from hand loppers to sickle-bar mowers, has been used to cut the sprouts. For larger areas, a simple and efficient technique is to use a gas-powered brushcutter with a circular saw blade. The whips can be directionally felled by rows and clones, and then picked up and bundled in the field. Tying the whips in bundles greatly facilitates transporting and storage. Tag each bundle with its clone number

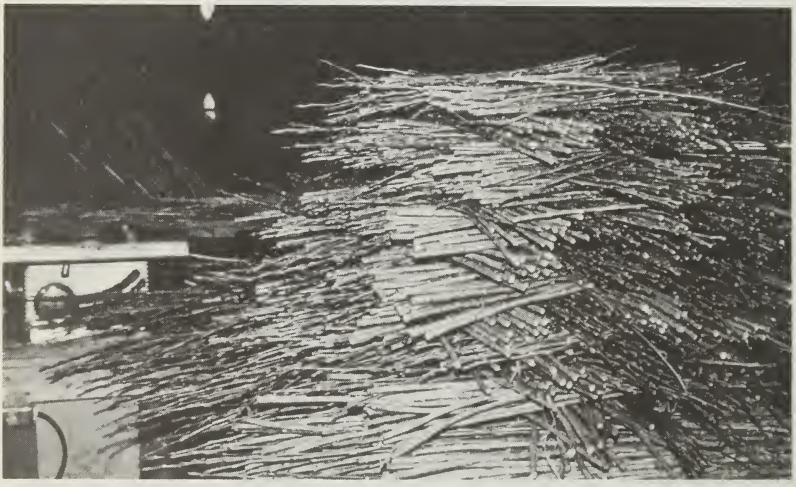
Whips from stools awaiting processing.

to avoid any mix-up in later processing steps. A five-person crew should be able to harvest 10,000 to 15,000 stools per day where the stools are at least 2 years of age.

Once the whips have been harvested and bundled, stack them in a storage area until processed. This storage area can be anything from an old shed to a pole barn, or the whips can even be piled outside. If an outside area is used, keep the whips out of direct sunlight and covered by plastic or a tarp to keep the air from flowing through the bundles. In winter, the whips lose very little moisture but air movement should be kept to a minimum. Cover the piles even if they are inside a building. Storage temperatures should remain close to or below freezing.

Here is an efficient method of making cuttings:

1. Remove the bundles from the storage area and place in large 32-gallon trash cans. Then cut the ropes and allow the whips to fall to the bottom of the can. This provides a rough grading by height. If the whips are too large (over 8 to 10 feet tall), simply place them on a table and remove according to size.



Whips counted and piled ready for cutting.

Cuttings in packages.

2. Take the taller whips one at a time from the containers and remove any side branches with hand clippers.

3. Count bundles in multiples of 10 whips and pile on a table near the cutting saw. These bundles can be as large as a person can hold in one hand (usually 10 or 20 whips). When the bundles are counted and placed on the table, arrange them so that the butt end of one bundle is opposite the butt end of its neighbor bundle. Repeat this until the surface of the table is filled. Continue piling with the next layer of bundles placed perpendicular to the bottom layer. This operation efficiently segregates the whips by size, orients all buds in the same direction, and provides a system for counting cuttings.

4. As the bundles are placed on the table, the person operating the cutting saw can then cut each bundle and keep count of the groups of cuttings being produced. Use hand counters to assist in keeping count of how many cuttings are processed. Although a band saw can be used to make cuttings, a 10-inch table saw is best.

5. Once a bundle is cut, place the cuttings in a plastic bag with all the buds facing the same direction. When the bag is full, place tags marked with the clone number and the number of cuttings inside and outside the bag. Use a hand stapler to close the bag.

During all phases of processing, pay close attention to removing any cuttings with signs of disease, insect or mechanical damage, or contaminations with other clones. Train all workers well to identify the various forms of injury and instruct them to remove cuttings with such symptoms.

The length of cuttings produced will vary with end use. For field planting, cuttings 8 to 12 inches long for hybrid poplars and 18 to 20 inches for eastern cottonwood are most common, with diameters of 3/8-inch to more than 1 inch.

If cuttings are all to be used in a nursery to produce rooted stock, then 6-inch cuttings from 1/2-inch to 1/8-inch in caliper are suitable. Cuttings smaller than 1/8-inch in caliper and 6 inches from the tip of the whip usually have lower survival rates than the larger ones.

An easy and practical way to store cuttings is in plastic bags 4 to 6 mils thick. For 10-inch cuttings, a bag 18 inches wide and 30 to 36 inches long will hold 150 to 500 cuttings. For 6-inch cuttings, bags that are 12 inches by 30 inches will hold 400 to 1,000 cuttings.

Although storage temperatures can be as high as 35°F, below freezing is best. Keep cuttings at those temperatures until they are ready for distribution. Avoid cycles of freezing and thawing.

General productivity figures are given in Appendix III.

Rooting Beds

Site Selection

Use typical nursery soils for rooting beds. The important consideration is the ability to get on the site with equipment in late fall. The soil should be a sandy or loamy sand. Other general guidelines are the same as those given for stool beds.

Site Preparation

For rooting beds, the soil should be well prepared. Again, the important factor is the elimination or control of weeds. Mechanical and/or chemical treatment will provide satisfactory control. Whichever method is used, control weeds as completely as for conifer transplants. The use of a plastic mulch has also been successful. Make a final fitting of the field with a rototiller just prior to planting, so that 6 to 8 inches of soil are loose and easily penetrable by the cutting. Add fertilizer similar to that prescribed for stool beds at this time.

Planting

Plant rooting beds by hand or by machine. Make cuttings 6 or more inches long and 1/8 to 1/2 inch in caliper. Because cuttings are simply pushed into the soil, planting by hand is usually faster and more economical. If the soil is well prepared, the cuttings will penetrate easily. This condition is essential for achieving high production

Cuttings planted in double rows in rooting bed. Rototiller used for cultivating and preparing the soil for planting.

rates. Plant the cuttings so that their tops are level with the soil surface. Do not allow more than 1 inch to protrude above the ground.

The spacing of cuttings in rooting beds depends largely on personal preference, land area available, weed control strategy, and available equipment. A spacing that has proven successful and efficient is a double row 2 to 3 inches apart with cuttings placed every $1^1/_2$ inches to 3 inches within the row. About 10 to 16 cuttings per linear foot of double row is a good target. Repeat these double rows every 36 inches or whatever is convenient for mechanical cultivation between pairs of rows. A planting density of 150,000 to 230,000 per acre can be obtained. The planters simply put a cutting on each side of a planting line. This technique adapts well to hand planting and production rates of 1,000 to 2,000 cuttings per man hour can easily be achieved. The piecework method of labor payment can easily be used if each bag is marked with the number of cuttings. Again, remember to prepare the ground well so the cuttings can be planted with little effort. After planting, irrigate the area well. This will help pack the soil around each cutting and also help to keep the cuttings moist, a necessity for good rooting. Maintain soil moisture close to saturation for 3 to 4 weeks after planting.

Keep cuttings in cold storage until they are planted. At the planting site, shade them from the sun to prevent any heat build-up inside the plastic bags.

Depending on the quality of cuttings used, the time of planting, and pre- and post-planting care, expect 50 percent to 75 percent of the cuttings to grow 1 to 6 feet during the growing season.

Maintenance

As previously mentioned, once planted, it is important that the soil be kept moist for 3 to 4 weeks. After that period, follow an irrigation schedule similar to that outlined for stool beds. Periodic fertilization with nitrogen at a rate of 100 to 150 pounds per acre per year until the first of August will also help increase height growth.

Keep the beds weed-free, especially for the first 2 months. Good weed control also facilitates harvesting in the fall. A combination of

Rooting trees 4 weeks after planting.

Rooting bed in August.

mechanical, chemical, and hand weeding will probably be necessary. Existing nursery equipment and techniques can readily be applied. Weed species present, soil type, and experience will dictate which ones to try. If in doubt, obtain professional guidance.

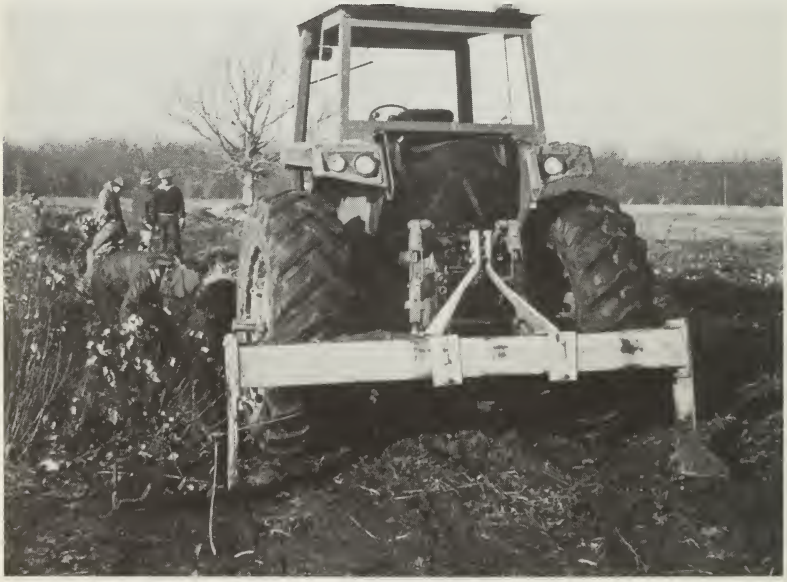
As in the case of stool beds, monitor insect and disease presence. Usually, pests do not severely attack first-year rooting beds, but this may vary with location. If the presence of insects or diseases becomes significant, seek professional assistance.

Harvesting and Grading Rooted Cuttings

Harvest rooted cuttings either in late fall when the plants are dormant or in early spring before the buds break dormancy. If the cuttings are planted in rows, use a side-mounted lifter to undercut the root system and loosen it from the soil. Poplars grow large roots that may be as much as 5 to 6 feet long at the time of lifting. A U-shaped blade works well in row plantings to prune the lateral roots. If a cutting is planted 6 inches deep, most of the root system will be in the top 8 inches of soil, so undercutting 9 to 12 inches will be sufficient. One-year-old rooted cuttings are flexible and may be undercut with standard bed lifters if the tractor is padded to prevent damage to the stems.

Once the trees are lifted, take care not to allow the root system to dry. Periodic watering and covering the stock with plastic will usually suffice.

To grade rooted cuttings, classify by size, remove culls, bundle in groups of suitable quantity, and prune excessively long roots. If the



Side-mounted lifter used for harvesting rooted stock.

trees are to be planted in 4 to 6 weeks, simply place the bundles in a large plastic bag (a 4-mil 30- to 40-gallon bag works well) with some moist sphagnum moss and store in a cooler. Storage temperature should be 40°F or below (28° to 34°F is best). If the trees are to be held through the winter, then either heel the bundles into the ground or put into plastic bags and hold at a temperature between 28° and 34°F. If they are stored in a cooler, then dip the root system in a fungicide and close the bag tightly around the bundles so that only the tops protrude. If the bundles are heeled into the ground, orient the stems parallel to the sun rays at noon to help minimize desiccation. When the ground thaws in the spring, package and distribute the trees.

Use Pesticides With Precaution

Pesticides used improperly can be injurious to man, animals, and plants. Follow the directions and heed all precautions on the labels.

Store pesticides in original containers under lock and key—out of the reach of children and animals—and away from food and feed.

Apply pesticides so that they do not endanger humans, livestock, crops, beneficial insects, fish, and wildlife. Do not apply pesticides when there is danger of drift, when honey bees or other pollinating insects are visiting plants, or in ways that may contaminate water or leave illegal residues.

Avoid prolonged inhalation of pesticide sprays or dusts; wear protective clothing and equipment if specified on the container.

If your hands become contaminated with a pesticide, do not eat or drink until you have washed. In case a pesticide is swallowed or gets in the eyes, follow the first aid treatment given on the label, and get prompt medical attention. If a pesticide is spilled on your skin or clothing, remove clothing immediately and wash skin thoroughly.

Do not clean spray equipment or dump excess spray material near ponds, streams, or wells. Because it is difficult to remove all traces of herbicides from equipment, do not use the same equipment for insecticides or fungicides that you use for herbicides.

Dispose of empty pesticide containers promptly. Have them buried at a sanitary land-fill dump, or crush and burn them in a level, isolated place.

NOTE: Some states have restrictions on the use of certain pesticides. Check your state and local regulations. Also, because registrations of pesticides are under constant review by the Environmental Protection Agency, consult your local forest pathologist, county agricultural agent, or state extension specialist to be sure the intended use is still registered.

Appendix I

Sources of Information on Poplar Culture

Location	Area of Expertise
Forest Science Laboratory USDA Forest Service Durham, NH 03824	Silviculture
Forest Science Laboratory USDA Forest Service PO Box 898 Rhinelander, WI 54501	Silviculture
Forest Science Laboratory USDA Forest Service 1407 South Harrison Road East Lansing, MI 48823	Entomology
USDA Forest Service North Central Forest Experiment Station 1992 Folwell Avenue St. Paul, MN 55108	Pathology
Michigan State University Department of Forestry East Lansing, MI 48824	Silviculture
Iowa State University Department of Forestry 221 Bessey Hall Ames, IA 50011	Pathology
Western Washington Research and Extension Center Washington State University Puyallup, WA 98371	Silviculture

RENRES Consulting Service 515 9th Street Manistee, MI 49660	Silviculture
Southern Hardwoods Laboratory USDA Forest Service Box 227 Stoneville, MS 38776	Silviculture Entomology

Appendix II

Herbicides Labelled for Use with Poplars

Casaron
Dacthal
Devrinol
Roundup

Herbicides not labelled for use with poplars but found effective in controlling certain weeds:

Enide
Goal
Lorox
Surflan

On all chemicals, follow manufacturer's recommendations for weed species controlled and spray rates.

Appendix III

Productivity Rates for Nursery Operation

Planting stool beds:	120-320 cuttings/man-hour
Harvesting stool beds:	250-375 stools/man-hour
Processing cuttings:	
10″ or 20″ cuttings:	250-500 cuttings/man-hour
6″ and 10″ cuttings:	400-2000 cuttings/man-hour
Planting rooting beds:	900-2000 cuttings/man-hour
Harvesting rooting beds:	700-1300 rooted cuttings/man-hour
Processing rooted stock:	100-300 rooted cuttings/man-hour